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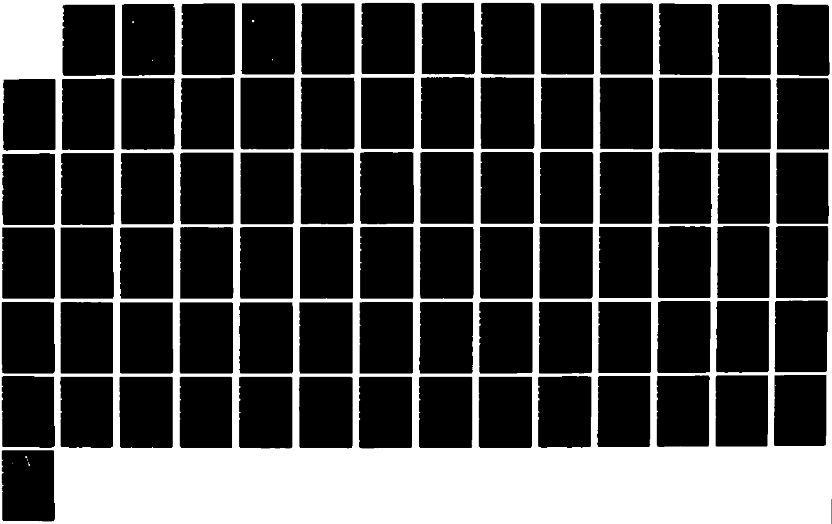

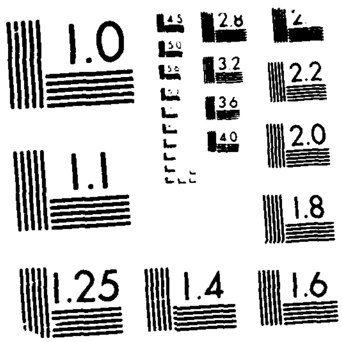

MICROCOPY RESOLUTION TEST CHART

Waste Minimization Program

Air Force Plant 85

Prepared for:

U.S. Air Force System Command
Aeronautical Systems Division/PMD
Wright-Patterson, AFB, OH 45433

Contract -F09603-84-G-1462-SC01

The Earth Technology Corporation

February 1986

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This report presents the findings of an assessment of hazardous waste minimization opportunities at Air Force Plant 85. This assessment was based upon a site investigation at the manufacturing plant, discussions with operators and subsequent analyses. Recommendations are made regarding methods to reduce the volume of hazardous waste disposed.

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Air Force Plant 85

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This report was prepared by the Earth Technology Corporation under Contract Number F09603-84-G-1462-SC01 for the AFSC, Aeronautical Systems Division (ASD/PMD). Mr. Charles H. Alford was the Project Officer for ASD/PMD. Mr. Richard R. Pannell was Program Manager and Mr. Brian J. Burgher, P.E., Mr. Douglas Hazelwood and Mr. Eric Hillenbrand were principal investigators for The Earth Technology Corporation.

Inquiries regarding this report should be directed to:

Mr. Charles H. Alford
Environmental Program Manager
Aeronautical Systems Division/PMD
Wright Patterson AFB, Ohio 45433
513-255-4466
Autovon 785-4466

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1.0 INTRODUCTION

This report presents the findings of an assessment of waste minimization opportunities at Air Force Plant 85 in Columbus, Ohio. It is part of the Waste Minimization Program being conducted by the Air Force Systems Command, Aeronautical Systems Division/Facilities Management Division (ASD/PMD) for eight (8) Government-Owned, Contractor-Operated (GOCO) facilities to promote prudent waste management by exploiting opportunities to limit land disposal, reduce costs and conserve resources.

A project team completed a site investigation of Rockwell International operations during the week of July 15-19, 1985 to review facility operations and discuss opportunities for waste reduction with plant engineering staffs. Based upon this investigation and subsequent analyses, this report presents the status of current waste generation and minimization programs and recommends other potential methods for reducing current waste volumes. Tables of waste volumes before and after minimization have been prepared to provide an indication of planned and projected waste reduction through system modifications. Finally, recommendations for implementation of opportunities which could further reduce waste generation and disposal are provided.

1.1 BACKGROUND

Interest in waste minimization has long been promoted by Federal legislation such as the Federal Water Pollution Control Act Amendments of 1972, the Energy Policy and Conservation Act of 1975 and the Used Oil Recycling Act, as well as DOD directives such as AFR 78-22 and DODD 19-14. More recently, the impetus for waste minimization has become even stronger. The reauthorization of RCRA includes bans on landfilling of certain waste types and a request for certification that waste minimization is being conducted by hazardous waste generators. Similarly, DOD has issued directives requiring zero land disposal of solvents by October, 1986 through its Used Solvent Elimination Program.

ASD/PMD anticipated these developments and initiated programs in 1983 to address these issues. A preliminary identification of resource conservation and recovery activities and opportunities was included in an environmental audit program conducted in 1983 for fifteen (15) facilities. ASD/PMD contracted a further study of resource conservation and recovery opportunities at eleven (11) GOCO facilities in 1984. This effort resulted in a preliminary assessment of resource recovery opportunities for industrial and non-industrial (i.e., solid or municipal) waste streams.

The methodology for this effort relied primarily on data acquired during the environmental audit program conducted in 1983 supplemented with conversations and information exchanges between the study team and GOCO contractor personnel. The results of this investigation were an indication of the areas where resource conservation and recovery opportunities appeared to be most substantial, and the areas where opportunities were not promising. Through application of a consistent methodology, facilities with substantial opportunities and measures warranting further investigation were identified.

The 1984 study demonstrated that plant operators were implementing methods that could substantially reduce waste generation volumes and raw material requirements to reduce their waste management costs and potential liabilities associated with waste land disposal. However, other opportunities for waste minimization were identified which appeared both technically and economically feasible but were not being implemented.

In light of the findings of these studies and the new certification requirements of RCRA, ASD/PMD is adopting a Waste Minimization Program. This program is promoting prudent waste management by exploiting opportunities to reduce costs and conserve resources. It is intended to establish for ASD/PMD the status of progress in this area, and to demonstrate facility advances in alternative waste management methods. In addition, it is expected that new opportunities determined to be infeasible in the past will be identified for possible implementation.

1.2 OBJECTIVES

The ASD/PMD Waste Minimization Program is designed to promote waste management opportunities which reduce the reliance on land disposal by GOCO facilities and which result in increased efficiency in the utilization of resources. As part of this program, this study has the following objectives:

1. Define the status of waste generation and existing minimization concepts at AFP 85.

2. Support feasible alternatives identified at AFP 85 by Rockwell.

3. Identify and evaluate new opportunities not being implemented at AFP 85.

4. Stimulate technology transfer between AFP 85 and other Air Force GOCO facilities as well as with other DOD installations.

5. Continue to increase the awareness of the importance of waste minimization.

6. Provide information needed to confidently certify that waste minimization is being employed at AFP 85 to satisfy RCRA requirements and DOD directives.

2.0 CONCLUSIONS AND RECOMMENDATIONS

Air Force Plant 85, located in Columbus, Ohio, is operated by Rockwell International. Operations at AFP 85 cover 345 acres and include 7 major buildings with a total area of 3.4 million square feet. Rockwell currently employs about 5,000 personnel working 7 days per week on 3 shifts. AFP 85 operations center on the production of B-1B subassemblies.

Rockwell generates significant quantities of wastes as a result of machining, surface preparation, and surface coating operations. In 1984, Rockwell generated a total of 1.8 billion pounds of waste of which only 953,000 lb were disposed off-site at a cost of $183,000. The rate of waste generation at Rockwell can be further reduced through additional minimization measures, being implemented and investigated by Rockwell.

A summary of the conclusions, recommendations and economics resulting from an investigation of waste minimization opportunities at AFP 85 is provided below.

2.1 CONCLUSIONS

This section presents a summary of the waste minimization measures being incorporated by Rockwell, as well as the alternatives being considered as part of waste minimization initiatives at AFP 85 and alternatives requiring further investigation, development or capital resouices prior to incorporation. A summary of 1984 waste disposal volumes, currently planned reductions, and additional potential reductions being considered by Rockwell is provided in Table 2-1. A brief description of reduction methods is provided in Table 2-2. An analysis of these data result in the following conclusions.

1. Recently implemented measures have reduced waste generation for off-site treatment by approximately 1 million lb/yr (120,000 gal). This was achieved by reducing the amount of coolant waste generated through the use of a longer lasting product.

   In addition, the following waste streams are currently recycled off-site, reducing the volume of waste requiring land disposal:

TABLE 2-1
AFP 85: ROCKWELL
PROJECTED WASTE DISPOSAL

WASTE STREAM	1984 GENERATION (POUNDS)	1984 LAND DISPOSAL (POUNDS)	PROJECTED LAND DISPOSAL W/PLANNED MINIMIZATION (POUNDS)	PROJECTED LAND DISPOSAL W/PROPOSED MINIMIZATION (POUNDS)
1. Acetone Waste	10,528	-	-	-
2. Stoddard Solvent Waste	10,352	-	-	-
3. 1,1,1-Tri-chloroethane Waste	42,350	-	-	-
4. Methyl Ethyl Ketone Waste	20,100	-	-	-
5. Lacquer Thinners	5,760	-	-	-
6. Other Thinners	5,760	-	-	-
7. Paint Booth Sludge	2,250	2,250	2,250	2,250
8. Out-of-Shelf-Life Paint	41,600	41,600	41,600	8,320
9. Chromic Acid Solution Waste	468,000	-	-	-
10. Acid Solution Waste	182,000	-	-	-
11. Mixed Acid Waste	157,000	-	-	-
12. Chromic Acid Sludge	6,000	6,000	6,000	6,000
13. Acid Sludge	2,600	2,600	2,600	2,600

TABLE 2-1
AFP 85: ROCKWELL
PROJECTED WASTE DISPOSAL

WASTE STREAM		1984 GENERATION (POUNDS)	1984 LAND DISPOSAL (POUNDS)	PROJECTED LAND DISPOSAL W/PLANNED MINIMIZATION (POUNDS)	PROJECTED LAND DISPOSAL W/PROPOSED MINIMIZATION (POUNDS)
14.	Waste Alkaline Etch	370,000	-	-	-
15.	Metal Finishing Rinsewaters	1.8×10^9			
16.	Wastewater Treatment Sludge	900,000	900,000	642,000	642,00
17.	Coolant Waste	2.16×10^6	-	-	-
	TOTALS	1.8×10^9	953,000	695,000	660,00
	% REDUCTIONS			27%	31%

TABLE 2-2
AFP 85: ROCKWELL
SUMMARY OF CURRENT, PLANNED AND PROPOSED
WASTE MANAGEMENT METHODS

	WASTE STREAM	PRESENT METHOD	PLANNED CHANGES	PROPOSED CHANGES
1.	Acetone Waste	Off-site recycle	None	On-site recycl
2.	Stoddard Solvent Waste	Off-site recycle	None	On-site recycl
3.	1,1,1-Trichloroethane Waste	Off-site recycle	None	On-site recycl
4.	Methyl Ethyl Ketone Waste	Off-site recycle	None	On-site recycl
5.	Lacquer thinners	Off-site recycle	None	On-site reuse as fuel
6.	Other thinners	Off-site recycle	None	On-site reuse as fuel
7.	Paint Booth Sludge	Landfill	None	None
8.	Out-of-Shelf Life Paints	On-site storage, no disposal method available	Reduce waste volume by switching from cans to plastic bottles	Evaluate off-site incineration of new waste stream
9.	Chromic Acid Solution Waste	Off-site treatment	None	Evaluate reduc tion by: 1) o site treatmen 2) Recovery b electrolytic regeneration
10.	Acid Solution Waste	Off-site treatment	On-site treatment	None
11.	Mixed Acid Waste	Off-site treatment	On-site treatment	None

TABLE 2-2
AFP 85: ROCKWELL
SUMMARY OF CURRENT, PLANNED AND PROPOSED
WASTE MANAGEMENT METHODS

	WASTE STREAM	PRESENT METHOD	PLANNED CHANGES	PROPOSED CHANGES
12.	Chromic Acid Sludge	Landfill	None	None
13.	Acid Sludge	Landfill	None	None
14.	Alkaline Etch Waste	Off-site treatment	None	Evaluate on-site recovery by: 1) crystallization, 2) lime recovery
15.	Metal Finishing Rinsewaters	On-site treatment	None	Evaluate on-s recovery by i exchange
16.	Wastewater Treatment Sludge	Landfill	Reduction by better dewatering	None
17.	Coolant Waste	Off-site treatment	Reduction by change to longer-life coolant	On-site recov

1. Acetone waste (10,500 lb)

2. Stoddard solvent waste (10,400 lb)

3. 1,1,1-trichloroethane waste (42,400 lb)

4. Methyl ethyl ketone waste (20,100 lb)

5. Lacquer thinners (5,800 lb)

6. Other thinners (5,800 lb).

2. Only a small amount of wastes generated at Rockwell are currently disposed of through land disposal. These are:

   1. Paint booth sludge (2,300 lb)

   2. Chromic acid sludge (6,000 lb)

   3. Acid Sludge (2,600 lb)

   4. Wastewater treatment sludge (900,000 lb).

   Other wastes generated are treated at one of several off-site facilities. These wastes include:

   1. Waste chromic, mixed, and other acids (807,000 lb)

   2. Alkaline etch waste (370,000 lb)

   3. Coolant waste (2.16 million lb).

   Rockwell currently has no means of disposal for waste touch-up paint and paint cans.

3. Waste minimization measures planned at Rockwell which have already been approved or funded will reduce waste generation by approximately 600,000 lb/yr. These measures are:

   1. Completion of wastewater treatment plant renovation to provide for on-site treatment of waste acid and mixed acid solutions.

   2. Replacement of the existing wastewater treatment sludge rotary vacuum filter with a filter press to improve sludge dewatering. These two plant modifications will further reduce current total land disposal from 953,000 lb to 695,000 lb, or a 27 percent reduction.

4. Additional opportunities for waste minimization at Rockwell have been identified. These include:

   1. On-site recovery of waste solvents for reuse as fuel or in place of new solvent purchases. On-site recovery of these wastes would reduce off-site solvent waste recycling by approximately 80 percent.

   2. Conversion from touch-up paint cans to small plastic bottles would reduce generation of this waste by 80 percent. The new waste stream may be amenable to disposal by incineration.

   3. On-site electrolytic recovery or treatment by chrome reduction of chromic acid solutions could reduce off-site treatment of this waste by over 90.

   4. On-site treatment of waste acid solution sludge by neutralization could render this sludge nonhazardous.

   5. On-site recovery of alkaline etch may be feasible. Depending upon the method of recovery, this would reduce off-site hazardous waste treatment of this waste by 98 percent; however, it may produce more nonhazardous sludge than the current weight of hazardous alkaline etch solution. Waste recovery may be feasible through lime precipitation or crystallization.

   6. On-site recovery of metal finishing rinsewaters through ion exchange may be feasible. Although ion exchange would produce a small amount of hazardous waste which would require off-site disposal, it would reduce the volume of wastewater produced at the plant by roughly 60 percent.

   7. On-site recovery of waste cooling oils through either centrifugation or coalescing plate filtration may be feasible. Recovered tramp oils can be reused on-site as fuel. This would reduce off-site disposal of this waste by nearly 100 percent.

2.2 RECOMMENDATIONS

Based on the findings of this waste minimization investigation of Rockwell operations at AFP 85, the following is an inventory of recommendations made with the objective of minimizing current waste disposal, or off-site management.

1. Acetone, Stoddard Solvent and Methyl Ethyl Ketone Wastes

   1. Evaluate on-site distillation of solvents for reuse based upon purity requirements for current uses.

2. Trichloroethane Waste

   1. Acquire a still for on-site recovery and reuse of waste solvent.

   2. Employ additive analysis and replenishment to extend solvent life.

   3. Instruct employees on importance of use of degreaser covers.

   4. Conduct management inspections to insure proper use of degreaser covers.

3. Lacquer and Other Thinners

   1. Investigate reuse of waste lacquers and other thinners as fuel on-site in plant boilers.

4. Out-of-Shelf-Life Paints

   1. Implement planned change to plastic touch-up paint bottles.

   2. Investigate off-site incineration of plastic touch-up paint bottles and waste paint.

5. Chromic Acid Solution Waste

   1. Evaluate on-site recovery by electrolytic regeneration and on-site treatment by chrome reduction.

   2. Investigate off-site recovery as an interim measure.

6. Acid Solution and Mixed Acid Waste

    1. Complete renovation of wastewater treatment plant currently being performed.

7. Acid Sludge

    1. Evaluate on-site treatment of acid solution sludge with lime.

8. Alkaline Etch Waste

    1. Evaluate the feasibility of on-site recovery through crystallization or lime precipitation.

    2. Investigate off-site recovery as an interim measure.

9. Metal Finishing Rinsewaters

    1. Evaluate the feasibility of on-site recovery using ion exchange.

10. Coolant Waste

    1. Evaluate cooling oil recovery through centrifugation or high efficiency filtration.

2.3 ECONOMICS

Table 2-3 summarizes the economics of the waste minimization measures investigated through this study. Economics are order of magnitude only and should not be used in place of detailed engineering estimates which consider contractor labor, engineering and administration costs and facility specific costs. Where costs were not available from Rockwell, estimates are based on standard cost references, vendor quotes or experience with similar capital projects.

TABLE 2-3
AFP 85: ROCKWELL
POTENTIAL WASTE MINIMIZATION ECONOMICS

WASTE	OPTION	CAPITAL COST	ANNUAL O&M COSTS	INCREASED ANNUAL SAVINGS[1]	PAYBACK
1. Acetone Waste	On-site recycle	$ 7,000	$ 320	$ 2,640	2.65 yr
2. Stoddard Solvent Waste	On-site recycle	$ 7,000	$ 320	$ 2,250	3.1 yr
3. Trichloroethane Waste	On-site recycle	$ 7,000	$ 770	$ 8,910	0.8 yr
4. Methyl Ethyl Ketone Waste	On-site recycle	$ 7,000	$ 600	$ 7,061	1 yr
5. Lacquer Thinners	On-site use as fuel	$ 1,000	-	$ 1,000	1 yr
6. Other Thinners	On-site use as fuel	$ 1,000	-	$ 1,000	1 yr
7. Chromic Acid Solution Waste	On-site recycle	$ 120,000	$ 3,830	$52,060	3 yr
8. Acid Sludge	On-site treatment	-	$ 300	$ 700	-
9. Alkaline Etch Waste	On-site recycle[2]	$ 160,000-170,000	$20,500	$20,000	8.9 yr
10. Metal Finishing Rinsewaters	On-site recycle	$ 310,200	$466,750	$23,000-135,000	2 - 13.5 yr
11. Coolant Waste	On-site recycle	$ 15,000-$ 80,000	$ 6,900	$27,300	0.5-2.9 yr

1 Savings include O&M costs
2 Assuming lime precipitation is used

3.0 WASTE MINIMIZATION PROGRAM
AFP 85: ROCKWELL

This section provides a description of current waste generation and management practices by waste stream at AFP 85 - Rockwell. A summary of these current practices is provided in Table 3-1. The following subsections present detailed descriptions of each waste stream and current management methods; waste stream material balances (where appropriate); opportunities for waste minimization; system economics; and recommendations for system implementation. This information is provided in support of the conclusions and recommendations provided in Section 2. Work sheets providing additional information for each waste stream are included in Appendix B.

3.1 ACETONE WASTE

3.1.1 Waste Generation and Management Practices

Fiber-reinforced plastic (FRP) part molding operations are conducted by Rockwell in the Foundry and Plastics Manufacturing Department in Building 3 at AFP 85. Acetone is used during molding operations for mold preparation and cleanup. Waste acetone is collected in drums in the manufacturing area; full drums are transferred to the hazardous waste storage area for storage prior to shipment. Waste acetone is shipped in drums to Solvent Resource Recovery, Inc. (SRR) in West Carrollton, Ohio, for fuel blending.

Waste composition data were not available for waste acetone. Based on the use patterns of the acetone, probable contaminants in the waste include resins, mold release agents, oil, dirt, and water. Acetone waste is estimated to be 90 percent acetone.

Waste acetone generation at Rockwell in 1984 was 10,530 lb (1600 gal). Due to decreased mold preparation activity, this generation rate is significantly lower than Rockwell's 1982 waste acetone generation rate of 30,000 lb. The cost for off-site recycling (including transport) in 1984 was $1.10/gal, for a total cost of $1,760.

3.1.2 Waste Minimization Opportunities

Waste acetone could be recycled on-site for reuse in FRP molding preparation and cleanup or, if the recycled product does not meet the purity requirements of this application, for paint cleanup. Generally, on-site recycling units do not produce solvent product of sufficiently high quality consistently to meet military specifications (mil specs) for new solvent. However, they can produce solvent within acceptable quality ranges for use except where particularly high quality is required.

TABLE 3-1
AFP #85 WASTE GENERATION RATES AND MANAGEMENT PRACTICES

WASTE	SOURCE/CONTENT	1984 GENERATION RATE	CURRENT MANAGEMENT PRACTICES	CURRENT[1] COSTS	CHANGES PROJECTED/COMMENTS
1. Acetone Waste	Fiberglass molding preparation and cleanup	10,528 lb (1,600 gal)	Collected in drums Drum transport Recycled by SRR	$ 1,760	None
2. Stoddard Solvent Waste	Hand cleaning of parts and machinery	10,352 lb (1,600 gal)	Collected in drums Drum transport Recycled by SRR	$ 1,760	None
3. 1,1,1, Trichloroethane Waste	Vapor degreasing and small part cleaning	42,350 lb (3,850 gal)	Collected in drums Drum transport Recycled by SRR	$ 2,450	Plan to send to Safety Kleen for recycling at lower cost
4. Methyl Ethyl Ketone Waste	Fuel tank sealing and sealant cleanup	20,100 lb (3,000 gal)	Collected in drums Drum transport Recycled or incinerated at CWM	$ 3,300	Each shipment disposed on a separate bid basis
5. Lacquer Thinners	Painting and paint cleanup (lacquers)	5,760 lb (800 gal)	Collected in drums Drum transport Recycled at SRR	$ 880	None
6. Other Thinners	Painting and paint cleanup (enamels, polyurethane)	5,760 lb (800 gal)	Collected in drums Drum transport Recycled at SRR	$ 880	None
7. Paint Booth Sludge	Paint booth water pits	2,250 lb	Collected in drums Drum transport Landfill by CWM	$ 1,200	None
8. Out-of Shelf life paint (16 cans)	Touch-up painting: pigment MEK	41,600 lb (104 drums)	Collected in drums Stored-no off-site facility will currently accept for disposal	-	Plan to switch to smaller touch-up bottles, reducing generation 80 percent
9. Chromic Acid Solution Waste	Spent anodizing baths	4.68×10^5 lb (51,050 gal)	Collected in portable tanks Pumped to storage tanks Bulk transport Treated at Tricil	$ 20,675(*)	Planned treatment in WWT system if new chrome reduction system approved

(1) Unit costs are provided in Appendix A
(*) Assumes average transportation cost of $0.045/gal.

TABLE 3-1
AFP #85 WASTE GENERATION RATES AND MANAGEMENT PRACTICES

WASTE	SOURCE/CONTENT	1984 GENERATION RATE	CURRENT MANAGEMENT PRACTICES	CURRENT[1] COSTS	CHANGES PROJECTED/COMMENTS
10. Acid Solution Waste	Acid cleaning and etching baths: -nitric acid -hydrochloric acid -sulfuric acid -nitric/ammonium bifluoride	1.82×10^5 lb (19,850 gal)	Collected in portable tanks Pumped to storage tanks Bulk transport Treated at Tricil	$ 7,227(*)	Planned treatment in WWT system by 9/85
11. Mixed Acid Waste	Acid cleaning and etching baths: -nitric acid -chromic acid	1.57×10^5 lb (17,100 gal)	Collected in portable tanks Bulk transport Treated at Nelson Industrial Services	$ 6,926(*)	Planned treatment in WWT system by 9/85
12. Chromic Acid Sludge	Anodizing bath -sludge -Cr^{6+}	6,000 lb	Shovelled into drums Drum transport Landfill by CWM	$ 2,200	None
13. Acid Sludge	Acid cleaning and etching baths	2,600 lb	Shovelled into drums Drum transport Landfill by CWM	$ 1,000	None
14. Alkaline Etch Waste	Alkaline chem milling	3.7×10^5 lb (34,000 gal)	Collected in portable tanks Pumped to storage tanks Bulk transport Treated at Tricil	$ 6,630	None
15. Metal Finishing Rinse-waters	Metal finishing rinses	1.8×10^9 lb	Pumped to treatment Treated on-site Discharged to sewer	$240,000 (excludes treatment)	None

(1) Unit costs are provided in Appendix A
(*) Assumes average transportation cost at $0.045/gal

TABLE 3-1
AFP #85 WASTE GENERATION RATES AND MANAGEMENT PRACTICES

WASTE	SOURCE/CONTENT	1984 GENERATION RATE	CURRENT MANAGEMENT PRACTICES	CURRENT[1] COSTS	CHANGES PROJECTED/COMMENTS
16. Wastewater Treatment Sludge	Treatment of rinse-waters, baths, and coal pile runoff	9×10^5 lb	Collected in treatment tank Dewatered Bulk transport Landfilled at CECOS	\$ 21,600(*)	Sludge production expected to resume 9/8. New filter press should reduce total total sludge volume by increasing percent solids. New off-site disposal facility will have to be found due to CECOS closure
17. Coolant Waste	Machining and cutting operations -95% water -5% oil	2.16×10^6 lb (2.6×10^5 gal)	Collected in machine sumps Transferred to underground storage tanks Bulk transport	\$ 40,300	Changed to Fleet 31 cooling oil due to longer life. Reduced waste volume approximately 1×10^6 lbs/yr

(1) Unit costs are provided in Appendix A
(*) Assumes average transportation cost of \$0.045/gal.

Some GOCO facility operators have interpreted the mil specs as applicable to solvents recycled on-site and, therefore, have not instituted on-site recycling. Other facilities, however, recycle solvents on-site utilizing purity standards which, although lower than mil specs, have allowed significant reductions in solvent waste volumes with no compromise of solvent use patterns or applicability.

Several distillaton systems are available which could be used for acetone recycling at AFP 85. Based on current solvent usage only a small unit would be required. Data on several such units are presented in Table 3-2. Typically, these units consist of either a compact distillation unit and storage tank or a combined cleanup work station, distillation unit, and solvent storage tank, which can be placed in the manufacturing area (all electrical components are explosion-proof). System operation is very simple. Waste solvent is dumped into a sink which drains into the distillation unit. As necessary, the distillation unit is switched on; separation of solvent from solids and other contaminants occurs automatically. Distilled solvent flows to a storage tank which provides solvent to the dispensing spout over the unit's sink; contaminants remain in the distillation unit. Some manufacturers, such as Finish Engineering and Recyclene, use a disposable plastic bag liner in their distillation units, eliminating fouling of the heating surface and simplifying still bottom disposal.

If acetone waste is 90 percent acetone, a 90 percent recovery efficiency is achieved, and recycled product quality is acceptable for reuse on-site, a savings of $2,640/yr for waste disposal and material purchase costs could be achieved. These savings are based on $2,400/yr of avoided new solvent purchases, $560/yr of avoided disposal costs, and O&M costs of $320/yr for the unit. A waste reduction of 1,300 gal/yr, or 81 percent, would be achieved. The estimated capital required to implement acetone recycling is $7,000; therefore, the payback period for recycling would be 2.7 years.

3.1.3 Recommendations

On-site acetone recovery appears to be economically feasible and should be evaluated for implementation at AFP 85. Rockwell should obtain an analysis of the acetone waste stream to accurately determine its composition. If the waste is greater than 70 percent acetone (the minimum operating limit for on-site systems), Rockwell should evaluate acetone quality requirements for its current use and determine if recycled acetone could be

TABLE 3-2
TYPICAL SOLVENT DISTILLATION SYSTEM SPECIFICATIONS

MANUFACTURER	UNIT	MAX. SOLVENT BOILING POINT	CAPACITY	COST
Finish Engr.	LS-15	320°F	15 gal/shift	$ 5,030
	LS-15V	500°F	15 gal/shift	$ 6,110
Recyclene	R-25	400°F	35 gal/shift	$ 11,900
Venus	SRS-5	320°F	56 gal/shift	$ 10,560
	SRS-5	500°F	56 gal/shift	$ 12,410
Brighton	7.5 GPH	350°F	60 gal/shift	$ 17,500

substituted for part of the total usage. If recovered acetone is not suitable for reuse, Rockwell should also evalaute potential use of recycled acetone in paint cleanup (spray-gun cleaning). If Rockwell determines that recycled acetone can be used in either the FRP molding or painting operations, Rockwell should purchase one stand-alone solvent distillation unit for acetone recovery. A unit with a capacity of 15 gal/shift (generally, the smallest unit offered) would be adequate for acetone recovery. At current generation rates, such a unit would be operated for one shift every two days, and could handle a significant increase in waste acetone generation.

3.2 STODDARD SOLVENT WASTE

3.2.1 Waste Generation and Management Practices

Stoddard solvent is used at Rockwell for cold cleaning aircraft parts, tools, and machines by hand and in cold degreasers. Waste solvent is collected in drums at part cleaning locations and transferred to the hazardous waste storage area. Drummed wastes are then transported to SRR for recycling through fuel blending.

Waste composition data were not available for waste Stoddard solvent at Rockwell. Based on the use of the material, contaminants in the waste solvent include grease, oil, and water; the waste is estimated to be 90 percent solvent.

In 1984, 10,350 lb (1600 gal) of Stoddard solvent waste were generated at Rockwell. The cost for recycling at SRR was $1.10/gal, for a total disposal cost of $1,760.

3.2.2 Waste Minimization Opportunities

Stoddard solvent could be recycled for reuse on-site. Recycled solvent would probably not meet mil specs; therefore, it would not be suitable for hand cleaning of aircraft parts, where residue would be unacceptable. However, it would be suitable for cleaning tools and machines, and may be within the operating range for contaminants for use in the cold cleaner. Therefore, segregation of new and recycled solvent for use would be required. A small unit could be used, similar to those discussed in Section 3.1.2; however, a higher operating temperature range (to 390° F) would be required. If 90 percent recovery is achieved and the solvent is acceptable for use in tool cleaning, machine cleaning, and in the cold cleaner, a savings of $2,250/yr could be realized. This savings includes savings of $2,010/yr on new solvent purchase and $560/yr on solvent disposal, and O&M costs of $320/yr for the unit. Waste generation would be reduced 1,300 gal/yr, or by 81 percent. The estimated capital required for Stoddard solvent recycling is $7,000; thus the payback period for Stoddard solvent reclamation would be 3.1 years.

3.2.3 Recommendations

Recovery of Stoddard solvent by on-site distillation appears to be economically feasible and should be evaluated by Rockwell. Rockwell should obtain an analysis of waste Stoddard solvent and determine waste composition. If the waste is 70 percent Stoddard solvent or greater, Rockwell should evaluate the possible use of recycled solvent in the cold cleaner and for tool and machine cleaning. Recycled solvent should be of adequate purity (over 99 percent) for these applications. Rockwell should also evaluate their ability to segregate new and recycled solvent by use (e.g., by use of color coded containers) within the plant to insure that recycled solvent will not be used in critical applications.

If recycled solvent is acceptable and can be segregated, Rockwell should purchase a small recycling unit. The smallest available units (15 gal/shift) have more than adequate capacity to recycle all the Stoddard solvent generated in the plant if operated for one shift every two to three days.

3.3 1,1,1-TRICHLOROETHANE WASTE

3.3.1 Waste Generation and Management Practices

Waste 1,1,1-trichloroethane is generated primarily in vapor degreasing, with some waste generated in hand cleaning of small parts. Vapor degreasing wastes are generated when degreaser solvents are replaced. Degreaser solvents are replaced when the total volume of makeup added equals five times the initial change, or when a check of the solvent's acid inhibitor content indicates acid inhibitor depletion. Waste solvent is transferred to drums which are stored in the hazardous waste storage area. Solvent waste generated in hand cleaning is collected in drums at the point of generation, and full drums are transferred to the storage area.

Waste 1,1,1-trichloroethane has been transported in drums to SRR for recycling as solvent, at a quoted cost of $0.30/gal. However, recycling of 42,350 lb (3,850 gal) of waste solvent at SRR in 1984 cost $2,450, or $0.64/gal. The cost difference is probably due to demurrage and loading costs or to excessive contamination in the waste. SRR has told Rockwell that their waste 1,1,1-trichloroethane has been used too long and had broken down due to additive imbalance, resulting in acid buildup. Rockwell currently has a bid from Safety Kleen to remove waste 1,1,1-trichloroethane at no cost for off-site recycling (excluding transportation). This alternate off-site management method could reduce costs by $2,450, the current cost of recycle at SRR.

3.3.2 Waste Minimization Opportunities

Waste 1,1,1-trichloroethane generated by Rockwell is currently recycled off-site for reuse. Alternative waste minimization practices could be implemented at Rockwell as discussed below.

3.3.2.1 On-Site Recycling

Waste 1,1,1-trichloroethane could be recycled on-site. A 15 gal/shift unit, such as one of those listed in Table 3-2, would be adequate for recycling the total 3,850 gal/yr of waste generated, operating one shift per day. The recovered solvent should be of sufficient purity to be suitable for reuse in vapor degreasers, but may not be suitable for critical hand cleaning of small parts. Generally, recovered solvent does not meet mil specs, but is substantially cleaner than the solvent in the degreasers as they approach one of the turnover (recharge) criteria.

For example, General Electric (GE) has been utilizing a simple distillation system for 7 years to extend the useful life of 1,1,1-trichloroethane in its vapor degreasers at AFP 59. Solvent is removed from the degreasers when pH or specific gravity analyses show that the solvent is outside established acceptance limits. These same limits, which are less stringent than mil specs for new solvents, are applied to the solvents after on-site recycling. If the recycled solvents fail to meet the minimum acceptance limits they are discarded; if they meet the limits they are reused in AFP 59 vapor degreasers.

Additionally, spent acid acceptors and other additives can be replenished based upon relatively simple analyses, significantly extending solvent life. Several distillation system vendors, such as Baron Blakeslee and Detrex, provide kits which are used to determine the additive levels in recycled 1,1,1-trichloroethane. Based on these test results, additives available from still manufactuers can be added as needed. Through the control of additive levels, solvent life can be extended as much as 20 times beyond current levels.

Based on the current 1,1,1-trichloroethane off-site recycle cost (Safety Kleen bid cost), a purchase cost of $4.00/gal, waste solvent purity of 80 percent, and recovery efficiency of 90 percent, on-site recycling would result in an annual savings of $8,910. These savings result from a decrease in solvent purchase costs of $12,480/yr (from $66,000 to $53,520), decreased disposal costs of $2,800/yr and O&M cost increases of $770/yr. The payback period for the $7,000 unit is 0.8 years. Waste reduction achieved would be 2,800 gal/yr.

3.3.2.2 Degreaser Covers

Approximately 75 percent of the 1,1,1-trichloroethane used annually at Rockwell, or 139,000 lb (12,650 gal), is lost as vapor. While the degreasers observed during the site visit were equipped with covers, some of them were open although no cleaning operations were occurring in the tanks at the time. An average uncovered vapor degreaser will lose approximately 0.5 lb/hr of 1,1,1-trichloroethane for every square foot of opening area. These losses are significantly increased when a draft is present. AFP 85 degreasers observed are equipped with induced-draft ventilation ducts adjacent to the degreaser openings. The draft created by these vents probably increases solvent vapor losses to an estimated level of 0.6 lb/hr-ft^2 by disturbing the cold air blanket (created by the degreaser chiller) which helps contain solvent vapors. Therefore, it is important that these covers be closed when the degreasers are not in operation. The savings from keeping vapor degreasers covered at all times except when actually in use are difficult to estimate; however, a conservatively estimated reduction in vapor loss of only 10 percent would save $5,000/yr.

3.3.3 Recommendations

It is recommended that Rockwell investigate an on-site recycling program for waste 1,1,1-trichloroethane. One 15 gal/shift distillation unit would be adequate to recycle all of this solvent waste, will reduce the volume of waste for off-site disposal by an estimated 72 percent, and will have a favorable payback period of less than one year. As an interim measure Rockwell should consider transfer of wastes to Safety Kleen to reduce off-site recycling costs by $2,450. Rockwell should however, carefully review Safety Kleen operations for regulatory compliance and operation.

It is also recommended that Rockwell advise its employees of the importance of judiciously using covers and periodically reinforce this message through spot checks by management.

3.4 METHYL ETHYL KETONE WASTE

3.4.1 Waste Generation and Management Practices

Methyl ethyl ketone (MEK) waste solvent is generated in fuel tank sealing and sealing cleanup operations at Rockwell. MEK is

used in preparing the two-part sealant used in sealing and in sealant cleanup (removing excess sealant and cleaning sealing equipment). Approximately 20,100 lb (3000 gal/yr) of MEK is generated at Rockwell. The waste is collected in drums at the point of use, stored, and shipped off-site in drums for disposal through recycling or incineration. Each shipment is disposed on a separate bid basis. Waste composition is estimated to be approximately 95 percent MEK, with small amounts of sealant. In 1984, waste MEK disposal costs were $1.10/gal, resulting in a total cost of $3,300 for the year.

3.4.2 Waste Minimization Opportunities

Waste MEK is currently recycled off-site, but may be recycled for reuse as solvent on-site in fuel tank sealing cleanup and paint cleanup. A 15 gal/shift system similar to that described in Section 3.1 can be used for recycling of the MEK waste stream. The MEK recovered should be of sufficient purity for use in some sealing cleanup applications (e.g., equipment cleanup), but may not be sufficiently clean for tank surface cleanup. Therefore, segregation of recycled MEK and new MEK will be important to prevent use of inappropriate materials for tank surface cleaning.

Economics for on-site recovery are favorable if the recycled MEK can be fully utilized on-site. Assuming the waste solvent is 90 percent MEK, and recovery is 90 percent, the annual avoided cost with recycling would be $7,060. Waste generation would be reduced by 2,430 gal, or 81 percent. Material purchase costs would be reduced by $6,600, disposal costs would be reduced by $1,100, and O&M costs would be $600. The payback period for the unit would be one year.

3.4.3 Recommendations

On-site recycling of MEK wastes is economically feasible at Rockwell if recycled product can be used on-site. Rockwell should obtain an analysis of the MEK waste stream to accurately determine its composition. If the waste is largely MEK (e.g., greater than 70 percent), Rockwell should evaluate MEK quality requirements for its current use and determine if recycled MEK could be substituted for part of the total usage. If not, Rockwell should also evaluate potential use of recycled MEK in paint cleanup (spray-gun cleaning). If Rockwell determines that recycled MEK can be used, Rockwell should purchase one solvent distillation unit for recovery. A unit with a capacity of 15 gal/shift (generally, the smallest unit offered) would be adequate for recovery. At current generation rates, such a unit would be operated for one shift per day, and could handle a significant increase in waste MEK generation.

3.5 LACQUER THINNERS

3.5.1 Waste Generation and Management Practices

Lacquer thinners composed of a mixture of toluene, xylene, and other solvents are generated in painting operations at Rockwell. Approximately 5,760 lb (800 gal) of lacquer thinners are generated annually. Thinners are collected in drums where generated and are transported in drums to SRR for recovery through fuel blending. The cost of off-site recycling is $1.10/gal resulting in a total disposal cost of $880.

3.5.2 Waste Minimization Opportunities

Waste lacquer thinners could be reused as fuel on-site through burning in the plant's coal-powered boilers, if the waste solvent mixture does not contain any chlorinated solvents. Boiler retrofit to install a small liquid nozzle and feed system in one of the plant's coal/gas dual fired boilers would be relatively inexpensive (approximately $5,000). Alternately, waste could be fed through the existing oil firing system in the plant's one oil/gas dual-fired boiler. Given the relatively small volume of these wastes, a feed rate of one gallon per hour or less would be adequate for complete disposal and should not adversely affect normal coal or oil combustion operation.

The mixed solvent thinner is estimated to have a Btu content of about 15,000 Btu/lb. Burning of this stream would yield roughly 8.5 million Btu/yr. At a coal fuel cost of about $1.00/MBtu, this would save about $960/yr; $880 from avoided disposal costs, and $80 from avoided fuel costs. Lacquer thinner requiring off-site disposal would be reduced 100 percent, or 800 gallons. The payback period is estimated to be in the range of one to five years, depending upon the approach taken to waste feeding.

Federal regulatory restrictions on burning wastes of this type in boilers have recently been enacted. 40 CFR 266 sets forth the regulation requirements for hazardous waste burned for energy recovery. Although these requirements are much less stringent than those required for TSD facilities, they should be reviewed by Rockwell to determine their impact on this recommended alternative.

These solvents are not candidates for on-site recycling for reuse as solvent because of the low volume of waste, and because the solvent product would not be of adequate quality to reuse for thinning and could not be used as a solvent in other paint operations.

3.5.3 Recommendations

It is recommended that Rockwell investigate use of lacquer thinners as a supplemental boiler fuel at AFP 85. If used as fuel in the plant's oil/gas dual fired boiler (mixed with oil), the capital cost for implementing reuse would be negligible, and payback would be immediate. If used as fuel in a coal/gas dual fired boiler, retrofit costs for liquid injection would be higher; a small storage tank, liquid feed system, and an atomizing nozzle would have to be purchased and installed. However, payback would probably still be good, particularly if other waste streams are to be used as fuel in conjunction with lacquer thinners (see Section 3.6 and 3.16).

3.6 OTHER THINNERS

3.6.1 Waste Generation and Management Practices

In addition to the waste lacquer thinners described in Section 3.5, other waste thinners are generated at AFP 85 in enamel and polyurethane painting operations. These wastes are collected in drums at the point of generation and are sent off-site to SRR for recycling by fuel blending. Waste composition data are not available for this waste, but it is probable that they are a mixture of toluene, xylene, and aliphatic and aromatic hydrocarbons.

Other thinners were generated at a rate of 5,760 lb (800 gal) in 1984, and were disposed off-site at $1.10/gal, at a total cost of $880.

3.6.2 Waste Minimization Opportunities

As with lacquer thinners, these other thinners may be used on-site as fuel in the plant's coal/gas or oil/gas boilers. The estimated heat recovered from burning is 85 million BTU/year, with an accompanying 100 percent reduction in off-site disposal rates for these wastes (800 gallons). The estimated annual savings through burning is $960/yr based on $880 from reduced disposal costs, and $80 from saved fuel.

3.6.3 Recommendations

It is recommended that Rockwell investigate use of other thinners on-site for fuel in combination with lacquer thinners, as discussed in 3.5.3.

3.7 PAINT BOOTH SLUDGE

Paint booth sludge is generated by Rockwell during periodic cleaning of water pits in downdraft and waterwall paint booths. The sludge consists primarily of paint solids and water. In addition, a definite solvent odor was noticed by plant personnel during the last cleanout, and the waste was therefore characterized as flammable, although paint booth sludge typically does not contain solvents because paint solvents volatilize readily. The sludge is removed from the paint booth pits, placed in drums and shipped to Chemical Waste Management for disposal. In 1984, 2250 lb of these sludges were disposed of at a cost of $200/drum. At an estimated weight of 400 lb/drum, the total annual disposal cost for this waste is estimated to be $1,200.

No cost-effective approach for reducing the volume of paint booth sludges has been identified. Filter press dewatering could slightly reduce the volume sent off-site for disposal. However, the volume of paint booth sludge is already small, and dewatering would not be cost-effective.

Alternatives to land disposal of paint booth sludges, particularly high-temperature incineration, should be examined. Although more costly than land disposal, incineration would result in significant reductions in future liability exposure.

3.8 OUT-OF-SHELF-LIFE PAINTS

3.8.1 Waste Description and Management Practices

Touch-up paints are used at Rockwell to correct minor flaws in or damage to primer coats, fuel tank coats and top coats. Touch-up paint kits are mixed in 2 gal batches in Detail Paint Dept. 804, Building 3 and are distributed to painters for use in one to eight ounce cans. Touch-up paint shelf life is six hours after mixing. When shelf-life is reached, painters reseal the touch-up cans containing the unused portion of paint and then deposit the cans in open-headed drums. Full drums are sealed and transported to the hazardous waste drum storage area. Currently, 104 full drums are in storage. No off-site facility has been found for disposal of these wastes.

The waste paint in the cans contains varied constituents, including chrome, other pigments, and methyl ethyl ketone. Polyurethane top coat paints, which are catalyzed, will set up solid in the closed can; primers and fuel tank coat will not set up completely, leaving some free liquid in the can. The presence of an unknown quantity of free liquids in the paint cans is the major reason Rockwell has had difficulty in finding an off-site disposal facility to accept these wastes.

3.8.2 Waste Minimization Opportunities

Rockwell is currently proposing to switch from the on-site mixing of touch-up paints, with dispensing in one to eight ounce metal cans, to the use of pre-mixed, frozen, touch-up paints in small (one-half ounce) plastic bottles. The change will reduce the volume of waste generated by touch-up painting an estimated 80 percent by reducing the volume of paint wasted and partially empty paint containers. This would result in a generation rate of 8,400 lb (21 drums/yr), as compared to the current generation rate of 41,600 lb (104 drums/yr.)

In addition to reducing the amount of waste generated, this change should produce a waste more amenable to off-site disposal. In particular, the waste plastic bottles and paint should be able to be disposed off-site by incineration in a hazardous waste incinerator.

3.8.3 Recommendations

Rockwell should investigate change over to pre-mixed touch-up paints in small plastic bottles as planned. In addition, Rockwell should investigate disposal of waste bottles through off-site incineration as a means of reducing potential future liabilities from disposal of this waste.

3.9 CHROMIC ACID SOLUTION WASTE

3.9.1 Waste Generation and Management

Chromic acid solution waste consists of spent anodizing bath generated by aluminum and titanium metal finishing operations at Rockwell. Spent baths are collected in portable tanks, transferred to the chromic acid tank at the industrial waste treatment facility, and bulk transported off-site for disposal at Tricil. Spent baths contain chromium, (approximately 40 percent of which is in the hexavalent state) and nitric acid. The waste exhibits a pH in the range of 1.5 to 1.7.

Waste chromic acid solutions are generated at an annual rate of 468,000 lb (51,000 gal) and are treated at Tricil at a cost of $0.405/gal (including transport). The total disposal cost for this waste is $20,700/yr.

3.9.2 Waste Minimization Opportunities

Rockwell is considering expanding the existing AFP 85 wastewater treatment plant chrome reduction capacity from 600 gal per 8 hours to 10,000 gal per 8 hours. This expansion would allow reduction of chrome in all waste chromic acid baths and full in-house treatment of these wastes, reducing off-site disposal of hazardous wastes by 51,000 gal and reducing off-site disposal costs by $20,700/yr.

Alternately, spent anodizing baths may be recycled on-site through electrolytic regeneration. Through this process, trivalent chrome undergoes anodic oxidation and is converted to hexavalent chrome. Other metal anions in solution are removed through cathodic deposition using selective perfluorosulfuric acid exchange membranes. Such a system is currently being implemented on a pilot scale by General Dynamics at AFP 4.

On-site electrolytic recovery could be performed continuously or as a batch process. In continuous operations, each process tank has a small recovery tank (approximately 5 percent of the process tank volume) in which a side stream from the process tank is continuously recovered and returned to the process tank. Concentrated waste solution containing trivalent chrome, copper, zinc, aluminum, and other reduced metals is removed for treatment or disposal.

Batch processing of spent anodizing baths would require taking spent anodizing baths to a new holding tank (approximately 6,000 gallon if 50 percent of a bath is replaced at a time) in the industrial wastewater treatment plant. The spent bath would be continuously processed in the regeneration tank, and regenerated baths would be pumped to a second new holding tank of equal volume. Regenerated baths could be used to replace the next bath to be regenerated and as makeup for evaporative losses. Concentrated solution containing zinc, copper, aluminum, and other reduced metals would be withdrawn and disposed off-site.

Assuming that the concentrated waste stream is 10 percent of the total volume, the cost of anodizing baths is approximate $0.75/gal and the cost of concentrate disposal is about $0.50/gal, process economics are estimated to be favorable. Waste reduction acheived would be 90 percent (45,900 gal), new material purchase costs would be reduced from $38,300 to $3,830, and off-site disposal costs would be reduced from $20,900 to $2,550. The annual avoided cost would be approximately $52,000/yr resulting in a payback period of 2.3 years for an estimated initial investment of approximately $120,000.

Finally, spent baths may be able to be recycled off-site (rather than treated off-site) while on-site treatment or recovery alternatives are being evaluated. Several off-site recovery operations have recently been established which can provide a cost-effective alternative to on-site treatment of spent anodizing baths. Typically, recovered materials have a value that exceeds the cost of recovery. Thus, commercial treatment facilities often offer a small net revenue for wastes. The actual cost or revenue resulting from waste recovery depends primarily on level of contamination, bath concentration and transportation distances. The suitability of the AFP 85 anodizing wastes for off-site recovery and resulting economics can only be determined through trial tests conducted by firms providing such services.

3.9.3 Recommendations

Rockwell should evaluate the feasibility of on-site recovery of anodizing baths by electrolytic regeneration as a means of reducing off-site disposal of waste chromic acid anodizing solutions, before proceeding with plans for increasing on-site chrome reduction capacity. Preliminary analysis indicates that on-site regeneration is economically feasible and would reduce hazardous waste generation substantially, while recovering valuable chromic acid baths. An evaluation of both alternatives (reduction and recovery) should be performed to determine the best approach for managing this waste. During the interim, Rockwell should evaluate off-site recovery as an alternative to the current means of off-site treatment. If recovery proves to be infeasible, plans to expand the treatment capability of the wastewater treatment system should proceed to reduce reliance on off-site treatment companies.

3.10 ACID SOLUTION WASTE

3.10.1 Waste Generation and Management

Acid solution waste consists of spent acid cleaning and etching baths from metal finishing and chem mill process lines. Spent baths are collected in portable tanks, transferred to a storage tank in the industrial waste treatment plant and transported off-site in bulk for treatment at Tricil. Waste acid solutions may contain nitric acid, hydrochloric acid, sulfuric acid, ammonium bifluoride, metal salts, nitrates, sulfides and sulfates.

Waste acid solutions are generated at a rate of 180,000 lb (19,800 gal) and are treated at Tricil at a cost of $0.365/gal (including transport). Total treatment costs for 1984 were $7,230.

3.10.2 Waste Minimization Opportunities

Acid solution waste has previously been treated through batch neutralization and flocculation in the industrial waste treatment plant. This operation was discontinued in 1984 to allow for renovation of the waste treatment plant. Treatment of these wastes on-site is expected to resume in September 1985; off-site disposal of these wastes will cease at that time.

3.10.3 Recommendation

Rockwell should proceed with treatment of waste acid solutions in the industrial waste treatment plant. No further recommendations are made.

3.11 MIXED ACID WASTE

3.11.1 Waste Generation and Management Practices

Mixed acid waste consists of spent nitric/chromic acid cleaning (deoxidizing) baths from the metal finishing process lines. Spent baths are collected in portable tanks, transferred to a storage tank in the industrial waste treatment plant, and transported off-site for treatment at Nelson Industrial Services. Waste acid mixtures contain nitric acid (10 percent by volume) and chromic acid and have a very low pH (approximately -0.4).

Mixed acid waste is generated at a rate of 157,000 lb (17,100 gal) and is treated off-site at a cost of $0.36/gal (including transport) for an annual treatment cost of $6,930.

3.11.2 Waste Minimization Opportunities

Mixed acid waste has previously been treated through batch neutralization and flocculation in Rockwell's industrial waste treatment plant. Treatment of waste acid mixture was discontinued in 1984 to allow for treatment plant renovation. Treatment on-site of waste acid mixtures is expected to resume in September 1985. This will effectively minimize the volume of hazardous waste generated by acid deoxidizing at Rockwell.

3.11.3 Recommendations

Rockwell should proceed with treatment of mixed acid waste in the industrial waste treatment plant. No further recommendations are made.

3.12 CHROMIC ACID SLUDGE

Chromic acid sludge is generated during cleanout of the chromic acid bath tanks at AFP 85. The sludge is shovelled into drums during tank cleanout and transported to CWM in drums for disposal. The sludge is both corrosive and EP toxic. Sludge generation in 1984 was 6000 lb, but annual generation is typically less than this figure according to Rockwell personnel. The cost for disposal is $200/drum including transportation; total disposal cost in 1984 is estimated at $2,200. No waste minimization opportunities were identified for this waste.

3.13. ACID SLUDGE

Acid sludge is generated during cleanout of the acid cleaning and acid etching bath tanks. These sludges are primarily metal salts, such as $AlCl_3$ produced in acid chem milling of aluminum with hydrochloric acid and nitric acid. Sludge is shoveled from the acid baths into drums and transported in drums to CWM for disposal by landfill (probably following solidification). Waste acid solution sludge is generated at a rate of 2600 lb/yr. Current disposal cost is $200/drum, for a total disposal cost of approximately $1,000/yr. No waste minimization opportunities are feasible for this waste.

3.14 ALKALINE ETCH WASTE

3.14.1 Waste Generation and Management Practices

Alkaline etch waste consists of spent aluminum chem mill and etching baths generated by metal finishing operations at Rockwell. Alkaline etch waste is removed from process tanks using portable tanks, transferred to a storage tank in the industrial waste treatment plant, and bulk transported for off-site treatment at Tricil. Waste alkaline etch bath is concentrated sodium hydroxide solution and contains aluminum, sulfide, sodium aluminate, and other dissolved solids.

Alkaline etch waste is generated at a rate of 370,000 lb/yr (34,000 gal). Off-site disposal at Tricil costs $0.195/gal (including transport), for a total annual off-site treatment cost of $6,630.

3.14.2 Waste Minimization Opportunities

Waste alkaline etch can be recycled through crystallization of aluminum content or through lime precipitation of aluminum and sulfides as calcium aluminate. Use of these processes has been investigated at several Air Force GOCOs, and lime precipitation is being implemented at AFP 3 by McDonnell Douglas.

The crystallization process operates by removing aluminum as aluminum trihydrate through crystallization at reduced temperature. The aluminum trihydrate settles and is removed in a slurry form with some chem mill solution, while the clarified chem mill solution is returned to the etch tank. The slurry is centrifuged and the centrate chem mill solution is returned to the crystallizers and recycled. Chem mill solution is

essentially 100 percent recovered. A limitation of this process is the degree of removal of aluminum; without excessive cooling and reheating of recovered solution, aluminum can not be removed below 5 oz per gallon. The process does produce a relatively small amount of sludge at high solids content which, in some cases, can be resold.

The lime process operates by reacting lime and aluminum to form tricalcium aluminate. Chem mill solution and lime are flash mixed and then clarified to remove the precipitated tricalcium aluminate. The chem mill solution is then returned to the chem mill tank and sludge is filtered to achieve 30 percent solids; recovered filtrate is also returned to the chem mill tanks. The process can produce a better chem mill solution (less residual Al) than the crystallization process, but produces much more sludge. It has been determined in pilot scale testing that greater than stoichiometric amounts of lime are required; as a result, the sludge product contains unreacted lime, which may result in a pH of over 12 (i.e., the sludge may be a hazardous waste due to corrosivity). Lime precipitation produces roughly 4 times as much dry sludge by mass as the crystallization process. Additionally, lime sludge does not dewater as well as crystallization sludge, so its moist mass is roughly 7-9 times that of crystallization sludge.

Both processes may produce hazardous sludge due to free sulfide content if not processed by centrifugation to remove suspended sulfides prior to aluminum removal. Additionally, lime sludge may be hazardous due to untreated lime unless neutralized.

Applicability of either of these processes to a particular etching operation and process economics are highly dependent upon etching bath operating parameters. Process economics are also dependent upon costs for disposal of sludge residue and the type of sludge desired (i.e., the degree of sludge processing required).

For example, based on Rockwell's aluminum chem mill replacement criterion of 115 gr/l Aluminum and pilot plant studies at Boeing and Grumman, lime precipitation of chem mill solution at AFP 85 would produce at least 539 tons of sludge per year. This sludge would be hazardous due to the presence of free sulfides (reactive) and excess lime (corrosive), unless the process includes a centrifugation step to remove sulfides before precipitation and a sludge neutralization step after precipitation. Without these modifications the process would

replace the current hazardous waste stream of 185 tons with one of 539 tons, with equally unfavorable economics. At a hazardous waste sludge disposal cost of $100/ton (including transportation), treatment and disposal costs with recovery would be approximately $61,000/yr. This is significantly higher than current operating costs which are $40,000/yr assuming a chem mill bath cost of $180/ton and current disposal costs.

However, with processing to produce non hazardous sludge, operating economics are much more favorable (at higher capital expense). At a nonhazardous sludge disposal cost of $25/ton, total lime purchase and sludge disposal costs would be $20,500/yr, which would be a 50 percent savings over current costs, and hazardous waste generation would be reduced roughly 98 percent (the only hazardous waste produced would be sulfide sludge removed by centrifuge).

A rough estimate of the capital cost for complete systems to yield nonhazardous sludges (including ultracentrifugation and lime sludge neutralization) is $160,000 for lime precipitation and $170,000 for crystallization, based upon costs for similar but larger systems (including consideration of scaling factors and excluding costs for enclosure).

As this example demonstrates, a detailed evaluation of process requirements (allowable and optimal Al concentration) and alternatives is necessary to evaluate the waste minimization potential and economic feasibility of either process; however, it is possible that either may be feasible at AFP 85.

Finally, spent alkaline etch may be able to be recycled off-site (rather than treated off-site) while on-site recovery alternatives are being evaluated. Several off-site recovery operations have recently been established which can provide a cost-effective alternative to treatment of spent etch solution. Typically, recovered materials have a value that exceeds the cost of recovery. Thus, commercial treatment facilities often offer a small net revenue. The ultimate cost or revenue resulting from waste recovery depends primarily on level of contamination, bath concentration and transportation distances.

3.14.3 Recommendations

It is recommended that Rockwell perform an engineering evaluation of the feasibility of on-site recovery of chem mill baths. Chem mill recovery may be technically feasible through either crystallization or lime precipitation. However, the economic feasibility of both methods is uncertain based on available information. A detailed evaluation of alternatives is warranted due to the ability to reduce off-site hazardous waste disposal approximately 98 percent (or by 360,000 lb/yr) through implementation of either alternative. In the interim, Rockwell should investigate off-site alkaline etch recovery services which may be able to dispose of this waste at lower cost.

3.15 METAL FINISHING RINSEWATERS

3.15.1 Waste Generation and Management Practices

Metal finishing rinsewaters are continuously generated during metal finishing operations at AFP 85 as parts undergoing plating, chem milling, or anodizing are dipped in rinse tanks to remove cleaning, etching, anodizing, and plating solutions. Rinse tanks at Rockwell are operated on a continuous overflow, once-through basis, which is generally the most water consuming method for metal finishing rinsing. Rinsewater flows over weirs running the length of the rinse tanks, is collected in troughs running behind the weirs, and is piped to the on-site industrial waste treatment plant. Rinsewaters are treated by neutralization, precipitation, and flocculation at the plant, and discharged.

It is estimated that 500,000-600,000 gal of rinsewaters are generated daily at Rockwell. Disposal of treated wastewater costs $8.06/MCF, or $1,077/million gal. Annual rinsewater disposal to sewer therefore costs roughly $190,000 to $240,000. Rinsewater purchase cost at a unit cost of $4.853/MCF are estimated to be $118,000 to $142,000 per year. Costs of on-site treatment are not available; however, if an average cost of $1.00/thousand gal is estimated for treatment, the annual treatment cost would be approximately $200,000.

3.15.2 Waste Minimization Opportunities

Waste rinsewaters may be amenable to on-site recycle using an ion exchange system for demineralization. The ion exchange process would reduce waste generation by substituting a concentrated, low volume regenerant waste for the current dilute, high volume wastewater. It would reduce existing rinsewater costs by reducing the volume of water purchased and the volume of wastes disposed.

Rockwell currently uses ion exchange to deionize feedwater for certain metal finishing rinses. Rockwell has experienced problems with the quality of the deionized feedwater produced by the system and the reliability of the system. However, it is important to note that Rockwell employees do not attribute these problems to the ion exchange process itself, but rather to the recently installed automated process control system. Prior to installation of this system, Rockwell employees reported that they had very few problems with the ion exchange system.

An ion exchange system could be located in the AFP 85 industrial wastewater treatment plant. The ion exchange system would require separate cation and anion exchange columns in series due to the presence of sulfides in the rinsewaters (a mixed exchange column would release hydrogen sulfide gas during regeneration).

The installation would require either two ion exchange process lines or dirty and clean water storage tanks to insure uninterrupted flow during regeneration cycles.

The economics of rinsewater recovery on-site are highly dependent on site-specific conditions such as ion concentration in rinsewaters. At AFP 85, the concentration of ions in rinsewaters is currently not known. However, a rough cost estimate for ion exchange was prepared based on an estimated rinsewater cation concentration of 11 meq/liter (from EPA literature). The preliminary assessment results indicate that waste reduction of 99 percent could be achieved, with an avoided cost of between $23,000 and $135,000/yr. Water use for rinsewaters would be reduced from 220 million gal/yr to approximately 89 million gal/yr, a reduction of 59 percent. The system would generate roughly 1 million gal of 10 percent sulfuric acid regenerant solution which could be treated on-site and about 700,000 gal of 10 percent sodium hydroxide regenerant solution which would have to be treated off-site due to the presence of sulfides. The estimated payback period for the system is 2.3 to 13.5 years. System economics are summarized in Table 3-3.

The economics of implementing such a system at Rockwell would be highly dependent on site-specific installation costs. For example, system costs estimated in Table 3-3 included $85,000 in plumbing modifications. Plumbing modifications at Rockwell could be considerably more or less, depending on the amount of existing plumbing that could be used for this system. It should be noted that Rockwell has investigated recovery of rinsewaters in the past and found it to be uneconomical.

3.15.3 Recommendations

Rockwell should reevaluate the feasibility of on-site recycling of rinsewaters by ion exchange in light of wastewater treatment system renovations and increased water and disposal costs. Initial evaluations indicate that installation of such a system may be economically feasible and would result in significant waste reduction. Site constraints such as space availability and the need for separate plumbing systems should be included in such an analysis, as should system reliability.

3.16 WASTEWATER TREATMENT SLUDGE

3.16.1 Waste Description and Management Practice

Wastewater treatment sludge is generated in Rockwell's wastewater treatment plant during the treatment of process rinsewaters, baths and coal pile runoff. Treatment processes employed include chrome reduction, neutralization, precipitation, and flocculation/sedimentation. Low solids wastewater treatment sludge is generated in the treatment plant clari-flocculator and is removed from the clari-flocculator as underflow. The sludge is transferred to the sludge tank where it is stored.

TABLE 3-3
PRELIMINARY ESTIMATE OF
ECONOMICS OF ON-SITE RINSEWATER RECOVERY

COST ITEM	CURRENT COSTS	WITH RECYCLING
Capital	-	310,000
Material Purchase	118,000-420,000	170,850
Treatment (On-site)	182,000-220,000	60,000
Disposal	190,000-240,000	35,900
Avoided Cost	-	23,000-135,000
Payback	-	2.3-13.5

Prior to July 1984, high solids sludge (25 percent) was produced through dewatering of the low solids sludge using the rotary vacuum filter. The dewatered sludge was transported in bulk for disposal in the CECOS hazardous waste landfill in Williamsburg, Ohio. At that time, high solids sludge generation was approximately 450 tons per year. At a disposal cost of $90 per ton, excluding transportation, the sludge disposal cost was $40,500/yr.

3.16.2 Waste Minimization Opportunities

Installation and use a filter press as part of Rockwell's wastewater treatment plant upgrade will reduce the mass and volume of dewatered sludge produced at Rockwell through improved dewatering. The rotary vacuum filter previously used for dewatering probably achieved a sludge in the range of 25 percent solids. The new filter press will produce a sludge with 35 percent solids, reducing the mass of sludge generated for off-site disposal by 28 percent, or 129 tons.

Based on the the most recent sludge disposal cost (excluding transportation) of $0.045/lb (1983), this improvement in dewatering would result in a savings of at least $11,610/yr.

The CECOS landfill in Williamsburg which offered sludge disposal for $0.045/lb has closed and a new disposal facility will have to be found. However, the relative cost savings realized by installation of the new filter press versus continued use of the old rotary vacuum filter is based on reduction in sludge mass and will not be affected by a change in the absolute disposal cost.

3.16.3 Recommendations

No recommendations are made for wastewater treatment sludge management at Rockwell. Installation of the new filter press will effectively reduce the weight and volume of sludge requiring off-site disposal.

3.17 COOLANT WASTE

3.17.1 Waste Generation and Management Practices

Metalworking operations at Rockwell (e.g., cutting, tooling, and turning) require coolants consisting of an emulsion of soluble oils and water. After prolonged use of the soluble oil/water emulsion, it becomes degraded as evidenced by rancidity, floating tramp oils or ineffective lubrication. Upon failure, coolants are collected from coolant sumps by a portable vacuum wagon and transferred to any of three underground storage tanks. Approximately 179,000 lb/mo (21,500 gal) were collected for storage in 1984. Waste lube and hydraulic oils from machine maintenance (approximately 100 gal/mo) are also mixed in these tanks with waste coolant oils.

Waste coolant is shipped to Tricil for treatment and disposal. Tricil treats waste cooling oils by breaking the oil/water emulsion, removing the oil fraction by skimming (for disposal by burning), and discharging the water fraction. The cost for treatment at Tricil is $0.155/gal (including transportation). At the 1984 generation rate of 2.2 million lb (260,000 gal), the annual cost for treatment is $40,300.

Soluble oil coolants are supplied by a number of manufacturers in the United States and, therefore, vary in composition. Rockwell utilizes Fleet 31 coolant. Typically, cutting fluids consist of:

- 60-90% mineral oils
- 1-5% water
- 5-30% emulsifiers
- 1-20% coupling agents
- 1-10% rust inhibitors
- 0-10% bactericides (e.g. chlorophenols, formaldehyde).

Cutting fluids are diluted with water at Rockwell to a 20:1 or 40:1 (water:oil) mix. Waste coolants generated from machining operations will typically be the oil/water coolant mix with 3-5 percent tramp oil and suspended metal particles. Waste coolants will also have reduced concentrations of additives such as emulsifiers and bactericides.

3.17.2 Waste Minimization Opportunities

Rockwell has recently reduced waste coolant generation by changing to Fleet 31 coolant oil from their previous coolant. Fleet 31 coolant has a longer useful life than the previously used coolant, and has reduced the volume of coolant waste

generated per month from 21,500 gal to 11,500 gal, for an annual decrease of 1 million lb (120,000 gal). At \$0.15/gal for disposal, this change will result in an annual savings in disposal costs of \$21,390. If the previously used coolant was similar in price to Fleet 31 (\$2.83/gal), a decrease in coolant purchase cost of roughly \$15,000/yr will also be realized, for a total savings of \$36,390.

Additional reduction in coolant waste generation can be achieved at Rockwell through implementation of a coolant recovery program. Advances in coolant recovery technology have allowed industrial facilities to greatly extend the life of coolants by reuse and thereby reduce costs for new cutting fluid purchases and treatment or disposal costs for waste coolant. Several technologies are commercially available to remove tramp oils and other impurities from coolants so they can be made-up with fresh cutting fluid and reused in machining operations. Two technologies that are most often applied for on-site coolant recovery are coalescing plate filters and centrifugation systems. Generally, centrifugation is more effective in separating tramp oils from coolant. However, centrifugal units are significantly more expensive, generally 5 to 10 times the cost of plate filtration systems.

Using either system, Rockwell can significantly decrease waste disposal from machining operations. System operation would involve transporting waste coolant, as it fails or on a regular cycle, to a recovery unit located in a central location. Wastes would be run through the recovery system resulting in separation of cleaned coolant from contaminants. Tramp oils and solids would be collected separately for disposal. Recovered coolant would then be tested and mixed with new coolant and reused in machining operations. To further extend the life of recovered coolant, bactericides may be added to delay bacteria growth and rancidity. Tramp oils can be burned on-site at Rockwell (along with hydraulic and lubricating oils) to recover energy in the dual fired boiler, or transported off-site for fuel-blending.

The economics of coolant recycling at Rockwell are good. Assuming that 25 percent of coolant oil is removed as tramp oil in each recycling cycle, and that removed tramp oils are used as fuel on-site, the annual cost for new coolant concentrate is reduced from \$17,100 to \$4,270, or 75 percent, and the annual cost for disposal is reduced to zero from \$21,390. Depending upon the system selected, the payback period for the recycling system would be either 0.5 years or 2.9 years. New coolant usage would be reduced from approximately 6,000 gal/yr (assuming 75 percent of coolant is mixed 20:1, and 25 percent is 40:1) to 1500 gal/yr; off-site disposal volume is reduced to zero from 138,000 gal/yr. Coolant recycling economics are summarized in Table 3-4.

TABLE 3-4
ECONOMIC ANALYSIS OF COOLANT RECOVERY OPTIONS

ALTERNATIVE	WASTE REDUCTION (GAL/YR) (%)	CAPITAL COST ($)	AVOIDED COST ($/YR)	O&M COST ($/YR)	NET SAVINGS ($/YR)	PAYBACK PERIOD (YRS)
1. Recovery by centrifugation	138,000 (100%)	80,000	34,200[1]	6,900[2]	27,300	2.9
2. Recovery by coalescing plate filtration	138,000 (100%)	15,000	34,200[1]	6,900[2]	27,300	0.5

1 Includes avoided disposal and raw material costs. Disposal costs are based on current unit costs of $0.155/gal. Avoided raw material costs are based on Fleet 31 costs of $2.83/gallon and 75% reduction in volume used.

2 Based on O&M unit costs of $0.05/gal

3.17.3 Recommendations

On-site coolant recovery appears to be a viable alternative for AFP 85 machining operations. It is recommended that Rockwell investigate alternative coolant recovery systems, including coalescing plate filtration and centrifugation units. Based on projected economics and system recovery efficiency, it appears that Rockwell should acquire a coolant reclamation system. This recommendation is further supported by new regulations proposed by EPA (50 CFR 49258) to classify waste oils as a hazardous waste. Economics of coolant recovery could be expected to become more favorable with such a change.

In addition if such a system is implemented, it is further recommended that Rockwell:

1. Use bactericide additives for recovered coolant to achieve greatest useful coolant life.

2. Recover coolant on a routine (e.g. monthly schedule to minimize coolant degradation and sump cleaning requirements, thereby extending coolant life.

3. Use deionized water for coolant makeup to reduce mineral build-up and extend coolant life (unless the coolant contains a calcium sequestering agent).

Control of the major factors causing coolant failure can result in even greater reduction in waste disposal volume and costs associated with coolant purchase and disposal.

APPENDIX A

APPENDIX A
UNIT WASTE MANAGEMENT COSTS

1. Solvent Resource Recovery, Inc.
   West Carrollton, OH

   A. Fuel Blending/Recycle.

      Organic liquids-no halogens - $55/drum[1]

   B. Halogenated Solvent Recycle

      1,1,1-Trichloroethane - $15/drum[1] (or more depending on contamination)

2. Safety Kleen
   Newark, OH

      1,1,1,-Trichloroethane Recycle - $0.00/drum[2] (based on preliminary Safety Kleen estimate)

3. Chemical Waste Management
   Emelle, AL

   A. Fuel Blending/Recycle

      Organic liquids - no Halogens - $55/drum[1]

   B. Drum Disposal

      Inorganic solids - $200/drum [1]

4. Tricil Corp.
   Hilliard, OH

   A. Bulk Treatment, Inorganic Wastes

      1. Chrome containing acid - $0.36/gal[2]
      2. Non-chrome containing acid - $0.32/gal[2]
      3. Wastewater treatment slurry - $0.16/gal[2]
      4. Alkaline Etch - $0.16/gal[2]

B. Bulk Transport - $0.03 - 0.06/gal

5. Nelson Industrial Services
Detroit, MI

Chrome containing acid - $0.36/gal[1]

6. CECOS (now closed)
Williamsburg, OH

Wastewater treatment sludge - $90/ton

---

1 Including transport
2 Not including transport

APPENDIX B

TITLE: Example calculation for solvent recovery	PROJECT NO.: AFP-85 PROJECT NAME:	PAGE 1 OF 2

Current Conditions:

Volume disposed : 1600g/yr

Cost of disposal : \$1.10/gal

Annual Cost = $\frac{1600g}{yr} \Big| \frac{\$1.10}{gal}$ = \$1760

Volume purchased = 2400g/yr

cost of material: \$1.85/gal

Annual cost = $\frac{2400g}{yr} \Big| \frac{\$1.85}{gal}$ = \$4440

\$6200

Recycling

Assume = Waste is 90% solvent

Recovery efficiency is 90%

Operating cost is \$.20/gal

Volume recovered = $\frac{1600g}{yr} \Big| \frac{.9g}{g} \Big| \frac{.9g}{g}$ = 1296 gal

Volume for disposal = 1600g - 1296g = $\frac{304g}{55g} \Big| \text{drum}$

= 6 drums

Volume to be purchased = 2400g - 1296 = 1104 gal

BY: EH DATE: 8/16	CHECKED BY: DATE:	The Earth Technology Corporation

TITLE: Example calculation for solvent recovery	PROJECT NO.: AFP 85 PROJECT NAME:	PAGE 2 OF 2

Volume processed: 1600 gal/yr

Process cost = $.20/gal

Annual cost = $\frac{1600 \text{ gal}}{\text{yr}} \Big| \frac{\$.20}{\text{gal}}$ = $320

Volume for disposal = 6 drums

Cost of disposal = $200/drum

Annual cost = $\frac{6 \text{ drums}}{\text{yr}} \Big| \frac{\$200}{\text{drum}}$ = $1200

Volume purchased = 1104 gal

Cost of material = $1.85

Annual cost = $\frac{1104 \text{ gal}}{\text{yr}} \Big| \frac{\$1.85}{\text{gal}}$ = $2042

$3562

Avoided Cost

Annual avoided cost = $6200 − $3562 = $2638

Capital cost

- One recycling unit, 15 g/hr — $6100
- Installation, including electrical and water — $900

$7000

Payback Period

Payback period $\frac{\$7000}{} \Big| \frac{\text{yr}}{\$2638}$ = 2.65 yr

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PLANT # 85
OPERATOR: Rockwell
DATE: 7/17

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Stoddard Solvent

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Hand cleaning parts and machinery. Sent to S&R for fuel blending. Collected at machine.

GENERATION
1. RATE: 1600 gal/yr
2. FREQUENCY:
3. COST: $ 1760 /yr

PROPOSED CHANGES:

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY: 2200 gal
3. COST: $ 1.55/gal

NOTES:

PLANT # 85
OPERATOR: Rockwell
DATE: 7/17/85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Methyl Ethyl Ketone

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: From sealing operations (fuel tanks) - sealant prep caulking - caulking cleanup (2 part sealant)
Not much from painting → paint solvent generally vaporizes.
Collected in 55-gallon drums - each shipment is separate bid

GENERATION
1. RATE: 3000 gal/yr (1984)
2. FREQUENCY: 1 truck per year
3. COST: $3300 /yr (1984)

PROPOSED CHANGES: Don't expect large increase in volume with increased production.

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY: 3750 gal/yr
3. COST: $2.7/gal

NOTES:

PLANT # 85
OPERATOR: Rockwell
DATE: 7/17/85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: 1,1,1 - Trichloroethane

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Vapor degreasing of parts
small part cleaning
QA Laboratory decides when turnover - Chemistry lab checks
each day of vapor degreasers to determine changeover
Drummed when removed from service - sent to Safety Kleen at cost
Newark, OH (no transportation)

GENERATION
1. RATE: 3850 gal/yr (74 drums/yr) (1984)
2. FREQUENCY: 1 truck per year
3. COST: $0.00 (current quote from SK) $.30 (cost from 588)
This could go up based on dirt and water
$2450 (1984)

PROPOSED CHANGES:

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY: 16,500 gal
3. COST: $4.00/gal

NOTES: Check with QA lab on criteria - Jeff Cornell (Chemist)
Safety Kleen only handles TCA Paul Gutridge (Supervisor)

PLANT # 85
OPERATOR: Rockwell
DATE: 7/17/85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Lacquer Thinners

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Painting and paint cleanup. Collected at generation in 55 gallon drums. Disposed at SRR (mixed for fuels)

GENERATION
1. RATE: 800 gal/yr (1984)
2. FREQUENCY: Annual
3. COST: $880/yr (1984)

PROPOSED CHANGES: Probably no increase - running close to capacity

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY: 1200 gal/yr
3. COST: $2.8/gal

NOTES:

PLANT # 85
OPERATOR: Rockwell
DATE: 7/17/85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Other Thinners

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Other coating operations - enamels polyurethane (polyurethane top coat). Thinners shipped to SRR for fuel blending

GENERATION 1. RATE: 800 gal/yr (1984)
2. FREQUENCY:
3. COST: $880/yr (1984)

PROPOSED CHANGES:

RAW MATERIAL DATA 1. CHARACTERISTICS:
2. QUANTITY: 1200 gal
3. COST: $2.1/gal

NOTES:

PLANT # 85
OPERATOR: Rockwell
DATE: 7/17

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Waste Flammable Solid Solvent + Paint Sludge

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Cleaning paint booths, sumps, etc. Drummed and shipped to CWM, Emelle

GENERATION
1. RATE: 2250 lbs
2. FREQUENCY:
3. COST: $ 200/drum (app) (includes trans.)

PROPOSED CHANGES:

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY:
3. COST:

NOTES:

PLANT # 85
OPERATOR: Rockwell
DATE: 7/17

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Out-of-shelf life paint

CHARACTERISTICS: Pigment + MEK (Pigment ~~[illegible]~~ includes Cr)

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: 1-8 ounce touch up paint cans with shelf life of 6 hours. Mixed daily used for touch up and then ~~[illegible]~~ unused portion disposed after 6 hours. Drummed now. No facility will take these drums at this time.

GENERATION 1. RATE: ~~[illegible]~~ (2 drum/wk)
2. FREQUENCY:
3. COST:

PROPOSED CHANGES: Expect to switch to small, ~~[illegible]~~ 1/2 ounce bottles with brushes. Less paint waste easier to ~~[illegible]~~ dispose of. Expect to reduce volume of waste roughly 80%

RAW MATERIAL DATA 1. CHARACTERISTICS:
2. QUANTITY:
3. COST:

NOTES: 3 paint kits - mix 2 gal each - Price per kit:
Primer - coppers - $27.70/kit
Deft - $19.17/kit
Fuel Tank Coat - $45.00/kit
Top coat - 26.00 - [45.00
base - 27.00

TITLE: Touch-up Paint Waste Weight	PROJECT NO.: AFP-85 PROJECT NAME:	PAGE 1 OF

Calculate paint can / paint waste per drum:

Assume: Avg. can is 4 oz can
Avg. can is 25% full
25% of volume in drum is wasted due to packing voids

Then: $\frac{50 \text{ gal}}{\text{drum}} \Big| \frac{4 \text{ qts}}{\text{gal}} \Big| \frac{32 \text{ oz}}{\text{qt}} = 6400 \text{ oz/drum}$

$\frac{6400 \text{ oz}}{\text{drum}} \Big| .75 \Big| \frac{\text{can}}{4 \text{ oz}} = 1200 \text{ cans/drum}$

$\frac{1200 \text{ cans}}{\text{drum}} \Big| \frac{4 \text{ oz}}{\text{can}} \Big| .25 = 1200 \text{ ozs paint}$

$\frac{1200 \text{ oz}}{\text{drum}} \Big| \frac{\text{qt}}{32 \text{ oz}} \Big| \frac{\text{gal}}{4 \text{ qt}} \Big| \frac{11 \text{ lb}}{\text{gal}} = 103.4 \text{ lbs paint}$

$\frac{1200 \text{ cans}}{\text{drum}} \Big| \frac{.25 \text{ lb}}{\text{can (empty)}} = 300 \text{ lbs cans}$

Total weight = 300 lbs + 103.4 lbs ~ 400 lbs

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D-6-1 7-84

PLANT # 85
OPERATOR: Rockwell
DATE: 7/17

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Waste Chromic Acid Solution

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Generated from alkaline and anodizing lines. Currently can not treat all because of [illegible] capacity (capacity is too small). Shipped off-site to Trizil

GENERATION
1. RATE: 51,050 gallons (234 tons)
2. FREQUENCY:
3. COST: $.~~3~~ .405 /gal (no transport)

PROPOSED CHANGES: ~~Hep~~ Increase ~~to~~ Cr^{6+} reduction capacity so can treat all this volume on-site rather than ship off-site.

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY:
3. COST:

NOTES: Transport typically $.02-.06/gallon

TITLE: Chromic Acid Recovery System	PROJECT NO.: AFP 85 PROJECT NAME:	PAGE 1 OF 2

Capital Requirements

Chromic acid bath size = maximum size = 11,000 gal

Changeout 50 percent of bath when $Cr^{6+} < 50\%$, so volume processed at changeout is 5500 gallons.

Then process requires one 500 gallon process tank and two 6000 gallon storage tanks

Equipment (with installation)

Process tank	65,000
2 - 6000 gallon holding tanks	5,000
Plumbing, pumps	2000
	72,000
Freight (3%)	2,000
Contractors O+P (30%)	22,000
subtotal	96,000
Contingency (10%)	10,000
subtotal	106,000
Engineering (10%)	11,000
Total	117,000 ~ 120,000

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TITLE: Chromic Acid Recovery System	PROJECT NO.: AFP 85 PROJECT NAME:	PAGE 2 OF 2

Operating Costs:

Recovery System

Operating cost per gallon: \$0.011/gal

Operating cost per year: $\frac{\$.011}{\text{gal}} \Big| \frac{51{,}000 \text{ gal}}{\text{yr}} = \$560$

Disposal cost, assume waste is 10% of treated volume, treated on-site.

Disposal cost per gallon: \$.50/gal

Disposal cost per year: $\frac{51{,}000 \text{ gal}}{\text{year}} \Big| .1 \Big| \frac{\$.50}{\text{gal}} = \$2550$

New materials cost:

Cost per gallon for makeup: \$.75/gal

Cost per year: $\frac{51{,}000 \text{ gal}}{\text{year}} \Big| .1 \Big| \frac{\$.75}{\text{gal}} = \$3830$

Total Cost = 6940 ~ 7000

Current System

Disposal cost:

$\frac{51{,}000 \text{ gal}}{\text{year}} \Big| \frac{\$.405}{\text{gal}} = \$20{,}700$

New materials cost:

$\frac{51{,}000 \text{ gal}}{\text{year}} \Big| \frac{\$.75}{\text{gal}} = \$38{,}250$

59,000

Cost Savings:

\$59,000/yr − \$7000/yr = \$52,000/yr

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PLANT # 85
OPERATOR: Rockwell
DATE: 7/17

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Waste Acid Solutions

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Acid cleaning and etching solutions

Sent to Tricil Env. Svcs., Hilliard, OH.

GENERATION
1. RATE: 19,800 gal (90.8 tons)
2. FREQUENCY:
3. COST: $.32/gal

PROPOSED CHANGES: Will go to WWTP when mods. are finished (9/85)

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY:
3. COST:

NOTES:

PLANT # 85
OPERATOR: Rakwell
DATE: 7/17

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Waste Acid Mixture (Chromic + Nitric)

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Acid cleaning and etching. Sent to Nelson Industrial SVCs, Detroit, MI

GENERATION
1. RATE: 17,100 gallons (78.4 tons)
2. FREQUENCY:
3. COST: 1.36 /gal

PROPOSED CHANGES: Will go to WWTP when modifications to plant are completed (9/85)

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY:
3. COST:

NOTES:

PLANT # 85
OPERATOR: Rockwell
DATE: 7/17

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Waste Chromic Acid Soln. Sludge (with Cr^{6+})

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Generated in process tanks. Residual sludge at bottom of the ~~ch~~ alodine/anodize tanks. Shovelled out into drums for disposal. CWM Emelle took for disposal.

GENERATION
1. RATE: 6000 lbs (1984)
2. FREQUENCY: Variable (less than 6000 lb/yr typically)
3. COST: $ 200/drum (app.) (incl. transport)

PROPOSED CHANGES:

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY:
3. COST:

NOTES:

PLANT # 85
OPERATOR: Rockwell
DATE:

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Waste Acid Sln. Sludge (w/out Cr)

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Acid cleaning and etching bath ~~[illegible]~~ bottom sludge from cleaning out bath tanks. Drummed and sent to CWM, Emelle

GENERATION
1. RATE: 2600 lbs/yr
2. FREQUENCY:
3. COST: $200/drum (est.) (includes transport)

PROPOSED CHANGES:

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY:
3. COST:

NOTES:

TITLE: Acid Solution Sludge Treatment with lime	PROJECT NO.: AFP-85 PROJECT NAME:	PAGE 1 OF 1

Stoichiometry

$Ca(OH)_2 + 2HCL \Rightarrow CaCl + 2H_2O$

Assume HCl = 3N (process specification)

Then [HCl] = 109.5 g/l = 3 eq/l

EW HCl = 36.5 g

Equivalents HCl: $\frac{109.5\,g}{l} \cdot \frac{eq}{36.5\,g} = 3\,eq.$

Lime Required

Assume sludge = 70% liquid.

Then: $\frac{2600\,lbs}{} \cdot \frac{.7\,lbs}{lb} = 1820\,lb$ 3N HCl

$\frac{1820\,lb}{8.36\,lb} \cdot \frac{gal}{} \cdot \frac{3.78\,l}{gal} = 823\,l$ 3N HCl

$\frac{3\,eq}{l} \cdot \frac{823\,l}{} = 2469\,eq$

EW Ca(OH₂) = 37 g

Weight lime required = $\frac{37\,g}{EW} \cdot \frac{2469\,eq}{} \cdot \frac{kg}{1000\,g} \cdot \frac{2.2\,lb}{kg}$

= 200 lbs

Cost

$\frac{200\,lbs}{} \cdot \frac{\$.05}{lb}$ = \$10 for lime

BY: EH DATE: 8/16	CHECKED BY: DATE:	The Earth Technology Corporation

PLANT # 85
OPERATOR:
DATE:

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Alkalin Etch

CHARACTERISTICS: High pH, high NaOH, some sulfide

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Generated in alkalin chem mill. Disposed at TriCil

GENERATION
1. RATE: 34,000 gal/yr
2. FREQUENCY:
3. COST: .205 /gal with transport

PROPOSED CHANGES:

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY:
3. COST: $0.09 / lb

NOTES:

TITLE: Alkaline Etch Recovery | PROJECT NO.: AFP - 85 | PAGE 1
PROJECT NAME: | OF 3

Lime Precipitation

Stoichiometry

$$Ca^{2+} + 2AlO_2^- \Rightarrow CaO \cdot Al_2O_3 \downarrow$$

Sludge Production

Theoretical sludge production = $\frac{3 \text{ lb dry solids}}{\text{lb Al}}$

Actual measured sludge, pilot scale

= $\frac{12 \text{ lb dry solids}}{\text{lb Al}}$

Rockwell baths replaced when Al = 115 g/l

= 15.3 oz/gal as Al

Assume desired removal is 12.5 oz/gal, then:

$$\frac{12.5 \text{ oz}}{\text{gal}} \Big| \frac{34000 \text{ gal}}{\text{yr}} \Big| \frac{1 \text{ lb}}{16 \text{ oz}} = 26{,}562 \text{ lb Al}$$

Lime sludge (30% moisture) =

$$\frac{26{,}562 \text{ lb Al}}{\text{yr}} \Big| \frac{12 \text{ lb dry}}{\text{yr}} \Big| \frac{\text{lb}}{.3 \text{ lb}} \Big| \frac{\text{ton}}{2000 \text{ lb}}$$

= 532 tons

Smut sludge =

$$\frac{\text{lb}}{.3 \text{ lb}} \Big| \frac{.16 \text{ lb}}{\text{lb Al}} \Big| \frac{26{,}562 \text{ lb Al}}{\text{yr}} \Big| \frac{\text{ton}}{2000 \text{ lb}} = 7 \text{ tons}$$

BY: EH | CHECKED BY:
DATE: 8/16 | DATE:

TITLE: Allkaline Etch Recovery	PROJECT NO.: PROJECT NAME:	PAGE 2 OF 3

Total sludge = 539 tons

Lime required = 7.9 lb / lb Al

$$\frac{7.9\ \text{lb}}{\text{lb Al}} \bigg| \frac{26{,}512\ \text{lb Al}}{\text{yr}} = 105\ \text{tons}$$

Rough estimate, operating economics:

Current costs:

Disposal: $$\frac{34{,}000\ \text{gal}}{\text{yr}} \bigg| \frac{\$.205}{\text{gal}} = \$6970$$

Material: $$\frac{3.7\times10^{5}\ \text{lb NaClt}}{\text{yr}} \bigg| \frac{\text{ton}}{2000\ \text{lb}} \bigg| \frac{\$180}{\text{ton}} = \$33\ 300$$

Total Annual = \$40,000

Costs with Recycle:

Disposal:
@ \$100 / ton $$\frac{540\ \text{tons}}{\text{yr}} \bigg| \frac{\$100}{\text{ton}} = 54{,}000$$
@ \$25 / ton $$\frac{540\ \text{tons}}{\text{yr}} \bigg| \frac{\$25}{\text{ton}} = 13{,}500$$

Material: $$\frac{105\ \text{tons Lime}}{\text{yr}} \bigg| \frac{\$65}{\text{ton}} = 6825$$

Annual Cost: @ \$100 / ton = \$61,000
@ \$25 / ton = \$20,500

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TITLE: Alkaline Etch Recovery	PROJECT NO.: AFP-85 PROJECT NAME:	PAGE 3 OF 3

Estimated Capital Costs[1]

Lime precipitation / non-hazardous sludge:

Process equipment (installed)	$ 114,600
Piping	2,000
Electrical	5,000
Control	13,000
Contingency (10%)	13,460
Engineering (10%)	13,460
Total	161,520 ≈ $160,000

Chrystallization / non-hazardous sludge:

Process equipment (installed)	$ 139,200
Piping	$ 2000
Electrical	$ 5000
Control	$ 4500
Contingency (10%)	15,070
Engineering (10%)	15,070
Total	$ 180,840 ~ 180,000

1 Based on downsizing cost estimates for larger systems considering scale economics. Does not include cost for enclosure (building).

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PLANT # 55
OPERATOR:
DATE:

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: [illegible]

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Treated [illegible]

GENERATION
1. RATE: 500,000 - 600,000 gal/day
2. FREQUENCY:
3. COST: —

PROPOSED CHANGES:

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY:
3. COST:

NOTES:

TITLE: Ion Exchange	PROJECT NO.: AFP 85 PROJECT NAME:	PAGE 1 OF 5

Ion Exchange Requirements

Assume average wastewater composition as follows:

11.18 meq/l cations
6.3 meq/l anions [1]

Use cation as design basis.

Assume 6 recycles per day. Equivalents to remove are:

$$\frac{100{,}000 \text{ gal}}{\text{recycle}} \left| \frac{3.78 \text{ l}}{\text{gallon}} \right| \frac{11.18 \text{ meq}}{\text{l}} = 4226040 \text{ meq/recycle}$$

Assume strong acid resin, exchange capacity of 350 meq/100 gram. Amount dry resin:

$$\frac{4226040 \text{ meq}}{\text{recycle}} \left| \frac{\text{Kg}}{3500 \text{ meq}} \right| \frac{2.2 \text{ lb}}{\text{Kg}} = 2656 \text{ lbs dry resin}$$

2656 × 1.2 (safety factor) = 3200 lb resin

1 From EPA estimate for aircraft production rinses

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TITLE: Ion Exchange	PROJECT NO.: AFP 85 PROJECT NAME:	PAGE 2 OF 5

Design Basis

Resin volume: Assume 50% moisture in operation
Bulk density = 43 lb/ft3
50% swelling when moist

$$\frac{3260\ \text{lb}}{.5\ \text{lb}} \Big| \frac{\text{lb}}{43\ \text{lb}} \Big| \frac{\text{ft}^3}{2} = 75\ \text{ft}^3 \text{ dry resin}$$
$$= 150\ \text{ft}^3 \text{ moist resin}$$

Size - one line contactors, 2 in series. Use surge tanks for storage and supply during recycle.

Assume column height = 12 ft, bed expansion 75 percent of bed depth:

$$\text{Bed depth} = \frac{12\ \text{ft}}{1.75} = 7\ \text{ft}$$

Then, column radius is:

$$\frac{150\ \text{ft}^3}{7\ \text{ft}} \Big| \frac{}{3.1415} = r^2 = 6.8$$
$$r = 2.5\ \text{ft}$$
$$d = 5\ \text{ft}$$

For anion, assume size is .75 cation, or 56 ft3 dry resin, 113 ft3 wet resin.

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TITLE: Ion Exchange	PROJECT NO.: AFP-85 PROJECT NAME:	PAGE 3 OF 5

Regeneration

H_2SO_4 Required:

$$\frac{4226040\ meq}{1000\ meq} \Big| \frac{eq}{} \Big| \frac{49\ g\ H_2SO_4}{eq} \Big| \frac{6\ rec}{d} \Big| \frac{365\ d}{yr} \Big| \frac{k}{1000\ g} \Big| \frac{2.2}{kg}$$

$= 1,000,000$ lbs H_2SO_4 @ 98%

At 10% H_2SO_4, $= \frac{1 \times 10^7\ lbs}{8.36\ lbs} \Big| \frac{gal}{} = 1.2 \times 10^6$ g

NaOH required:

$$\frac{2370060\ meq}{1000\ meq} \Big| \frac{ew}{} \Big| \frac{40\ g}{ew} \Big| \frac{6\ rec}{d} \Big| \frac{365\ d}{yr} \Big| \frac{kg}{1000} \Big| \frac{2.2\ lb}{kg}$$

$= 456,757$ lbs

At 50% NaOH, $=$ 913,515 lbs

At 10% NaOH, $=$ 9,135,150 lbs

$= 1 \times 10^6$ gal

Water required @ 150 gal/ft³/rinse:

$$\frac{150\ gal}{ft^3} \Big| \frac{150\ ft^3}{} \Big| \frac{6\ rec}{d} \Big| \frac{365\ d}{yr} = 5 \times 10^7\ gal/yr$$

$$\frac{150\ gal}{ft^3} \Big| \frac{113\ ft^3}{} \Big| \frac{6\ rec}{d} \Big| \frac{365\ d}{yr} = 3.7 \times 10^7$$

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D-6-1 7-84

TITLE: Ion Exchange	PROJECT NO.: AFP 85 PROJECT NAME:	PAGE 4 OF 5

Operating Costs Evaluation

Current:

Waste Rinsewaters	1.8×10^8 gal	- 2.2×10^8 gal
Disposal @ \$8.06 / MCF	\$ 190,000	- 240,000
Water Purchase @ \$4.753 / MCF	\$ 118,000	- 142,000
Treatment, @ estimated \$1.00 per 1000 gallons	\$ 182,000	- \$220,000
	\$ 490,000	- 602,000

With Ion Exchange:

Purchase:

H_2SO_4, 98%	\$ 68,800
NaOH, 50%	35,800
Cation resin, 33% repl./yr	2500
Anion resin, 33% repl./yr	6,000
Water	57,750
	\$ 170,850

Disposal:

H_2SO_4, 10%, treated onsite @ \$.05 / gallon	\$ 60,000
NaOH, @ \$ .20/gal	140,000
Water (rinses), assume does not require treatment	95,900
	\$ 295,900

\$ 467,000

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TITLE: Ion Exchange	PROJECT NO.: AFP-85 PROJECT NAME:	PAGE 5 OF 5

Avoided Cost: $23,000 - 135,000

Capital Cost Estimate:

Cation and anion columns	$130,000
Installation	19,500
Acid and Alk. tanks	4,000
Controls	20,000
Storage - existing tanks	
Additional Plumbing	85,000
Sub total	258,500
Contingencies, 10%	25,850
Engineering, 10%	25,850
	310,200

Payback: 2.3 - 13.5 years

BY: EH DATE: 8/16	CHECKED BY: DATE:	The Earth Technology Corporation

PLANT # 85
OPERATOR: Rockwell
DATE: 7/17

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Wastewater Treatment Sludge / Slurry

CHARACTERISTICS:

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Treatment of acid rinse and baths and coal pile runoff. Sludge goes to CECOS - slurry to Trici. Slurry generated only temporarily while old rotary press out of commission. New press will be installed. Trici used to be Systech. Slurry shipped in bulk to Trici by tanker. Sludge has been disposed at CECOS, Williamsburg, which is now closed - will need to find new contractor for sludge when it gets

GENERATION
1. RATE: 1415.3 Tons slurry (450 tons sludge) 240 Tons in '84
2. FREQUENCY:
3. COST: $90 / ton (sludge) (1983) Not incl. trans. - CECOS
Slurry = $.16/gal (not inc. transport)

PROPOSED CHANGES: Switched from sludge to slurry 7/84. Will switch back to sludge as soon as new filter press is installed (9/85?)

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY:
3. COST:

NOTES:

PLANT # 85
OPERATOR: Rockwell
DATE: 7/17

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: Cooling [illegible]

CHARACTERISTICS: 20 ~~40~~ : 1 water to oil

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: Check maintenance for volume/year. Stored in sump to each machine; Have 3 underground tanks for storing used oil. Used oil sent to Tricil. (Tricil skims oil and discharges water).

GENERATION
1. RATE: 21,500 gal/month (oil/water mix)
2. FREQUENCY:
3. COST: $ .125/gal + $.03/gal transport

PROPOSED CHANGES: Changed last month to Fleet 31 - reduced cost per month by $4000 app. due to longer life, less disposal (dropped volume waste 10,000 ~~gal~~ gal/month)

RAW MATERIAL DATA
1. CHARACTERISTICS:
2. QUANTITY:
3. COST:

NOTES: Check maintenance for cost of oil amount used per year

[illegible] - $ 1420

3pm [illegible]

1627 1620

1420

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